UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ENGINEERING

RECENT DEVELOPMENTS IN COTTON GINNING RESEARCH

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The Cotton Ginning Laboratories at Stoneville, Mississippi, are operated for the benefit of the entire south by the United States Department of Agriculture, through its Bureaus of Agricultural Engineering and Agricultural Economics, to whom are respectively assigned the engineering and cotton quality responsibilities. In the absence of our ginning technologist colleagues from the Bureau of Agricultural Economics, I shall endeavor to handle both the engineering and cotton quality phases of ginning in this discussion and am utilizing the data and information from the latter Bureau in so doing.

The question that is frequently uppermost in the mind of the progressive ginner who is endeavoring to render the farmer a beneficial service, is how to modernize and what does it comprise. A full answer to this question is not easy, but there are some very significant developments in modernization which have been made at the U. S. Cotton Ginning Laboratories, and we shall briefly attempt to acquaint you with them.

The requirements of a modernized cotton ginning plant have been fully covered in recent articles which have been released from the Laboratories in the various cotton ginners' publications, and which are being more thoroughly covered in a bulletin which is now in the hands of the government printer.1/

Means for protecting the purity of planting seed have recently received considerable attention, and in those states that are menaced by insect pests special apparatus for sterilizing the planting seed and combating destructive infestation must also be incorporated in a modern gin.

GIN BUILDINGS

The general trend in the gin buildings of today is distinctly toward single-story and one and one-half story gins in which all of the

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1/ "Modernizing Cotton Gins", by Chas. A. Bennett, F. L. Gordes and T. L. Baggette.

machinery, including the press, is at ground level; or in which only the press is elevated. Wooden framing with metal sheathing and roofing is being used in some of the buildings where economy of construction is a prime consideration, but all-metal buildings are rapidly growing more and more in favor. The concrete floors of the single-story gins are being raised above the exterior ground level sufficiently so that conveyors, seed pipes and even lint flues may be submerged below the operating floor level when desired.

There are many advantages which also reside in the recent structural steel buildings for cotton gins. These include overhung side shelters without posts, which have been damaged frequently in the older styles of gins; and there are also provided better means of lighting, ventilating and operating freedom.

GINNING EQUIPMENT

Exceptional improvements which have been made in cotton ginning machinery during the past eight years have brought all-steel machines to the industry; standardized methods of saw construction, spacing and sharpening; improved ribs and roll boxes; better balanced brushes and more effective airblast nozzles. Distributors, cleaners and feeders have also been materially changed for the better during this period.

Outstanding in this epoch of ginning reorganization has been the introduction and adoption of driers and conditioners by the more progressive cotton gins of the country. Our cotton technologists have pointed out the primary necessity for farmers to improve their harvesting practices, but where there are unavoidable periods during the ginning season when green, damp or wet seed cottons are encountered, the solution for improved ginning rests in the utilization of cotton driers. It has been demonstrated in our laboratory that the average value of lint ginned from green, damp or wet cotton was enhanced $.70 per bale for a group of short staple cotton to $2.50 per bale for a group of long staple cotton by artificially drying them and improving the resulting grade. There were more than 550 driers in operation at the close of the 1937-38 ginning season, and these had to their credit the drying of approximately 1,000,000 bales for the single season. Most of the 12,700 cotton gins in the United States require the use of a conditioner or drier at frequent intervals during their operation, and thus far only a beginning has been made in the adoption of driers by the ginning industry and adaptation of economical forms to the individual gins.

In problems of cotton drying it must be kept in mind that the Government process, which is used by virtually all factory-built driers for the adequate protection of the seed cotton, requires a volume of approximately 40 cubic feet of hot air per pound of damp seed cotton, a period of exposure ranging from a few seconds to a minute or more, and a temperature which is preferably maintained between 160 and 175 degrees for the early season cottons and up to 220 degrees for the late season, rain soaked lots.

The U. S. Cotton Ginning Laboratories have developed two distinct forms of driers which may be home made, one being the vertical tower type and the other the airline cleaner drier. The vertical tower may vary from 7 to 17 floors in height and its general construction and kinds of installation are covered in Miscellaneous Publication No. 239, "The Vertical Drier for Seed Cotton", and Miscellaneous Publication No. 314, "Overhead Cleaner Driers". A very recent development of the low tower drier which may be very economically applied to cotton gins without the use of a separator, converts the present suction separator of a gin into a receiving or blow box which is properly vented through the roof of the gin building. The pressure delivery system of drying in combination with the low tower is especially applicable to two-story gins if the drier is to be located within the gin building. Many gins, however, prefer to use the full length tower with this type of installation and place their tower at the most convenient location outside the building.

For pneumatic ginning systems having airline cleaners, the Government design airline drier is very simple and beneficial.

The description and diagrams of the vertical drier are here given for your information and are not intended to be a special endorsement by the United States Department of Agriculture for this particular form of drier alone, because the Government process is being used by the various manufacturers in factory built units and it is not our intention to influence the individual ginner in regard to his selection of the kind of drier which he may buy. In order, therefore, that we may maintain a fair and impartial attitude toward all of the manufacturers who are cooperating with us, it may be said that the vertical and airline driers have been discussed because they are a distinct development of the cotton ginning laboratories and can consequently be described impartially. It is a fixed policy of the United States Cotton Ginning Laboratories not to make comparisons of manufactured units.

COTTON PIPING, FANS AND POWER

The several pneumatic systems employed in the cotton ginning establishments of our country afford a startling opportunity for radical improvement and drastic modernization, with a view to the lowering of operating costs and the increasing of efficiency. The cotton ginners of the United States are well aware that their fans comprise a profit thief, but the problems of piping and different forms of installation have heretofore presented many difficulties. The cotton ginning laboratories have completed about one-half of the fan and piping tests which are scheduled in the research program, which will total approximately 10,000 tests. In the 5,000 tests which have thus far been conducted, several developments are already worthy of mention.

Many gins use much larger sizes of cotton handling pipes than are necessary, and it has been shown in the tests that oversized pipes cause the consumption of unnecessary power in the supplying of cotton to the gin stands.

Ten-inch pipes should be ample in size for supplying cotton to three-stand gins; 11-inch pipes to four-stand outfits; and 12-inch pipes to five-stand gins. Where no long suctions from cotton houses have been involved we have been able to handle plenty of cotton through the 10-inch pipe for a 3-80 outfit with 10 horsepower; enough cotton for the 4-80 outfit through a 11-inch pipe with 14 1/2 horsepower; and enough for a 5-80 outfit at approximately 18 horsepower.

Where very strong suction of 4500 feet per minute velocity has been employed in pipes of different sizes, it may be said that each increasing inch in size requires approximately 3 1/4 more horsepower. Thus, for long cotton storage runs on a typical 4-80 outfit if we go from a 10-inch pipe, in which our horsepower expenditure is 15 horsepower, an 11-inch pipe with equal suction will take slightly more than 18 horsepower; a 12-inch pipe, approximately 21 1/2 horsepower; and a 13-inch pipe, approximately 24 3/4 horsepower. These figures are only approximate for the purposes of illustration. If the 10-inch pipe will therefore do for most cotton gins without excessive power consumption, it is obvious that increasing the size of the suction pipe burdens the cotton ginner with a continuous waste of power.

A series of tests conducted on separators in connection with our cotton piping has disclosed the startling fact that even the best separator construction may not be able to prevent a loss of from 24 to 46 per cent. Examples of these are as follows: In one test with a 12-inch pipe the fan was actually handling 2,877 cubic feet of air, but only 2,174 cubic feet were passing through the cotton suction telescope. In another case with a 10-inch pipe, 5,031 cubic feet of air were being handled by the fan, while only 2,692 cubic feet were being drawn up through the wagon telescope. In both cases the leakage of air was unprofitable to the ginner and occurred at the separator. In contradistinction to such losses which occur with the standard suction fans and separators, we have been able to use Rembert types of fans and eliminate these losses entirely. About 10,000 bales were handled during the 1937 season at two representative gins cooperating with the Laboratory, and in each of these gins no separator was used. Cotton was drawn from the storage bin or wagon by a Rembert type fan and blown into a drier or receiving box without the use of any separator. In approximately 540 cotton quality appraisals made during Rembert fan tests at the Cotton Ginning Laboratories, it was found that these fans had no damaging effect on the quality of either long or short staple cotton, and although the handling time was slightly greater in the case of the Rembert fans than with the standard fans and separators, nevertheless, the economy of operation was strongly in favor of the Rembert fans.

It is therefore evident that one of the most promising means for decreasing the power consumption at cotton gins may lie in the use of Rembert fans. Old forms of separators now employed at cotton gins are very adaptable to conversion from suction to blowing in connection with these fans, and by the use of a 30 or 36-inch vent through the roof of the gin house the old stationary-screen forms of separators may be very successfully used. In one instance near the Laboratory, the beater was removed from a B-Box separator and over 2,200 bales of a well known Mississippi long staple cotton was handled by a seed breeder without any damage and with a most gratifying improvement in his ginning system.

The present form of perforated disc which is being used by the various manufacturers is a great improvement upon the old screens, which formerly produced serious fire hazards. Thousands of bales are now being handled every year by the present designs of Rembert fans without fire hazards or damage to the cotton quality, and it is believed that hazards with the Rembert fans, on the whole, do not amount to as much as are now encountered with existing separator installations. At the Laboratory we are operating a No. 35 casing with a 6-blade No. 30 wheel at 1900 r.p.m. on a 10-inch suction and discharge with approximately 10 horsepower, and can obtain enough cotton for 3-80's without any difficulty. Other tests with this same fan on 11-inch suction and 11-inch discharge gave us a strong suction with 10.7 horsepower, and for 12-inch suction and discharge we had a strong suction with 11.5 horsepower. The larger sizes of Rembert fans, however, apparently used more power than this small laboratory unit, upon which many of our tests were made. Nevertheless, in the light of our present investigations, we believe that a ginner should be able to supply plenty of cotton to his outfit with a fan power expenditure of not more than 5 horsepower per gin stand.

Summarizing the findings from our tests to date, it may be said that many gins should be able to materially reduce their horsepower consumption by reducing the size of their cotton suction piping.

In the Mississippi River Valley the practice of blowing seed with the discharge from the cotton suction fan is very prevalent. This practice is objectionable because it may contaminate the seed with spores, fungus and dirt; and the gin owner objects to it principally because it is very wasteful in its power requirements. It is, therefore, recommended that no cotton suction fan be employed to blow seed but rather that a small individual seed blowing fan be utilized and that the cotton suction fan and piping be modernized to bring about that economy which will permit the use of an individual seed blowing fan and still result in the saving of power.

Ability to maintain purity of the customer's seed is a problem now seriously confronting the ginners of the United States. It is possible that cotton restrictions may lead to definite requirements on even such small quantities as single bales. It is possible, however, for the ginner to maintain seed purity in a number of ways, such as the use of a flat seed belt in front of the stands or a seed blowing pipe with rotary feeders beneath each stand or with an accessible seed augur delivering to a blow pipe which will permit the entire system to be quickly cleaned out. Seed blowing alone, however, may be accomplished with a pure air fan at an expenditure of not more than 1-3/4 horsepower per gin stand if the piping is properly proportioned. The method of conveying gin run seed for oil mill purposes with conveyors is excellent and need not be altered even though some provisions may undoubtedly be necessary in the future for protecting the purity of the planting seed.

In a new cotton ginning installation which is being made by the Farm Security Administration in Georgia, the seed from the gin stands will be dropped into a seed blowing pipe through a rotary valve and will be

thence conveyed into a cyclone over the seed scales. After the seed has been weighed out it will then be discharged into a second branch from the seed blowing fan, whose discharge has been balanced against that of the seed scales. This second branch will convey the seed pneumatically to the grading and sacking machines or cotton storage.

CLEANERS, EXTRACTORS AND GINS

The all-steel cleaners, extractor-feeders and gin stands of today constitute a marked improvement over those upon which we began our tests some eight years ago, and the manufacturers are to be congratulated upon their contributions of improved construction in ginning machinery. It has been repeatedly pointed out by the Department that no amount of mechanical handling can really replace the careful hand picking on the part of the farmer. The various cleaning and extracting units and elaborate combinations of the same tested in our laboratories have consistently failed to remove enough foreign material from roughly harvested or snapped cotton to cause its ginned lint to be equal in quality to that from clean, hand picked cotton handled by the simpliest system available.

Even where gins may be fitted with the most modern cleaning and extracting apparatus, care should be exercised in advertising the fact, because it may lead to the adoption of bad harvesting practices on the part of the farmer, who may be laboring under the impression that since the ginner has a cleaner or drier, he can bring any sort of cotton to the gin and expect maximum quality and turnout.

The Laboratory has not found any particular difference in performance, cylinder for cylinder, between the latest types of airline cleaners and gravity cleaners. The selection of the cleaners, therefore, should be influenced by other considerations than the more effectiveness of the respective types. Throughout the Southeast the use of unit extractor-feeders in place of drum cleaning feeders is in most cases a development toward improved ginning, especially when these can be accompanied by an assurance that they will handle dry cotton or will operate in connection with driers. In the gin stands themselves the ginning laboratories have obtained better quality and performance from huller front than from plain gins. With standard 12-inch saws, now universally used in present day huller gins, it has been found by test that increases in tooth fineness, or the number of teeth per saw, up to 300 teeth gave increases in capacity and turnout without detriment to lint quality. Similar improvements were noted when straight back teeth, instead of the old style roach or excessive curved-back teeth, were employed on saws within the fineness range of 264 to 300. Naturally any improvement in lint turnout results in a corresponding gain to the farmer who owns the cotton.

Gin saw teeth should be kept in first class condition in order to obtain maximum capacity and lint quality. A most startling finding in this connection has been that with regard to the sharpening of the saws. When the saws have been sharpened on an average of seven times, their diameter has been sufficiently reduced by the combined wear and sharpening to produce

a drop in capacity of approximately 20 per cent, and the ginner should therefore refill his cylinders with new saws when they have been reduced in diameter by approximately 1/16 inch.

The speed of the saws has been definitely proved to be a secondary matter and many of the older ginning plants with huller gins have stepped up the speed of their saws from approximately 400 r.p.m. to 500 r.p.m. with an attendant increase in capacity and no resultant damage to the farmer's cotton. In certain instances where rate of feeding was not increased, the seed roll operated at less density and actually the higher speed produced lint of better grade than that ginned at the lower speed. It is a serious mistake to attempt to increase capacity by stepping up the feeding, because this causes tightening of the seed roll. Tight seed rolls are very detrimental to lint quality, particularly if the cotton has a good staple length or is in a damp condition.

The care and maintenance of brushes in brush gin systems is very important to quality ginning. Poor brushes lower the grade value and lengthen the time required for ginning, due to inefficient doffing. In experimental tests when an effort was made to obtain a ginning capacity with poor brush ginning equivalent to that secured with good brush ginning, the damages, in addition to lint turnout losses, definitely occurred with the damp cottons causing bale value losses of $1.50 with the longer and $0.80 with the shorter staple cottons.

It is not necessary that there be a fixed ratio between the speed of the gin brushes and gin saws so long as the brushes operate at a tip speed of approximately 6,666 linear feet per minute, which is ample for a range of saw speeds between 400 and 600 r.p.m. Tests at the laboratories on air-blast pressures for air-blast gins indicated that 12 inches of pressure measured on the U-tube water gauge at the nozzle of the gin stand gave the best average results.

CONCLUSION

From the view-point of the U. S. Cotton Ginning Laboratories, the modernization of cotton gins in the next few years will definitely tend toward increased simplicity, the elimination of faulty fans and incorrect piping, the utilization of driers, unit extractor-feeders, huller gin stands and pure seed apparatus.

The installation of driers and conditioners in the Southeastern States has barely begun, and their use is of such tremendous importance to the cotton farmers of the South that the more progressive Southeastern gins will undoubtedly rapidly adopt them.

The State Extension Services of the Southeastern States are now employing cotton ginning specialists who have received special training at the cotton ginning laboratories and are working with the ginners of their respective states toward modernization and better service. These cotton ginning specialists do not represent any regulatory or law enforcement agencies and their

cooperation with the cotton ginners is entirely voluntary. Their fund of information and their ability to assist the ginner should prompt him to make full use of their services.

The Cotton Ginning Laboratories are working hand in hand with the cotton ginning specialists of your states and cordially invite you to consult him in regard to your problems and to visit the laboratories whenever you have an opportunity.